REMARKS

Claims 1-4, 6-11, 14-17 and 33-34 are pending. Reconsideration and allowance of the pending claims is respectfully requested.

Specification

The title is objected to as not being descriptive. Accordingly, the title has been amended and withdrawal of the objection is respectfully requested.

Claim Rejections § 103(a)

Claims 1, 3, 4, 6-10, 12, 14-16, 33 and 34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over United States Patent Number 6,118,181 to Merchant et al (hereinafter "Merchant") in view of United States Patent Number 5,702,962 to Terasawa (hereinafter "Terasawa"). Claims 2, 11 and 17 were rejected under 36 U.S.C. § 103(a) as being unpatentable over Merchant and Terasawa and further in view of United Stated Patent Number 5,668,033 to Ohara et al. (hereinafter "Ohara"). The Applicant respectfully disagrees.

The References

Merchant describes a system and method for bonding wafers. Although Merchant describes integrated circuits on two wafers, Merchant recites that "most conventional wafer bonding processes are not suitable for bonding wafers that include CMOS circuitry and other temperature sensitive components because the relatively high temperatures associated with the bonding process can damage the CMOS circuitry or other temperature sensitive components." *See Merchant, Col. 1, Lines 34-39.* Merchant then describes an instance of such an undesirable and unacceptable bonding technique in the following excerpted portion:

> In addition, it is often undesirable to use eutectic bonding in order to bond two wafers together because the existence of liquid phases in these processes can sometimes lead to rapid dissolution of underlayers and, hence, a loss of process control. Furthermore, maintaining precise separation distances between two wafers bonded via eutectic bonding can be difficult since the surfaces of the eutectics typically deform when a temperature close to the eutectic's melting point is reached. *Merchant, Col. 1, Lines 52-62.*

Consequently, Merchant describes a bonding process that uses palladium in response to the undesirability of eutectic bonding. Merchant also cautions that "one skilled in the art should realize that substituting for the silicon and/or palladium may affect the temperatures associated with the bonding process". *See Merchant, Col 6, Lines 24-23 and 17-19.* Therefore, Merchant explicitly cautions against the use of materials other than palladium and against the use of eutectic bonding.

Further, Merchant describes the following:

> It should be further noted that the adhesion of palladium to chromium has been found to depend directly on the cleanliness of the chromium layer 29 surface. Therefore, it is preferable to perform a brief (i.e., approximately 1 to 2 minutes) 150 W rf sputter-etch cleaning of the chromium layer 29 surface just prior to application of the palladium layer 27 to the chromium layer 29. *Merchant, Col. 4, Lines 31-37.*

Thus, Merchant discloses sputter-etch cleaning of the chromium layer before adhesion of the palladium. Nowhere does Merchant disclose, teach or suggest a bond structure having an alloy that is sufficient to remove a native oxide.

Terasawa describes a fabrication process for a static induction transistor. In the fabrication process of Terasawa, an oxide film is removed with hydrofluoric acid, as shown in the following excerpt:

> The naturally formed oxide film is then removed with hydrofluoric acid as needed, and the N.sup.- substrate 10 and the N.sup.+ substrate 20 are subjected to ultrasonic

> cleaning with purified water and dried by a spin dryer at room temperature *Terasawa, Col. 4, Lines 47-50.*

To clean the surfaces, Terasawa describes the following:

> The N.sup.- substrate 10 and the N.sup.+ substrate 20 are then subjected to ultrasonic cleaning with an aqueous solution of sulfuric acid and hydrogen peroxide, thereby removing organic substances and metals on the substrates. *Terasawa, Col. 9, Lines 13-16.*

Thus, Terasawa discloses the use of acids to remove oxide films and clean surfaces. Nowhere does Terasawa disclose, teach or suggest a bond structure having an alloy that is sufficient to remove a native oxide.

Ohara describes a method for manufacturing a semiconductor acceleration sensor device by "covering a movable portion by use of a cap". *See Ohara, Col. 1, Lines 51-52.* Ohara describes the bonding of the cap as follows:

> Also, preferably, a gold (Au) film is adhered to the leg portion of the cap forming wafer. Where the bonding frame is made to be formed using silicon (Si), when in the bonding step heating is performed up to a temperature higher than an Au/Si eutectic temperature, the gold film comes to function as a bonding layer, with the result that it is possible to obtain a tough bondage easily. Further, when the gold film is also adhered onto the inner surface of the cap, the gold film can be also made to function as an electromagnetic shielding layer. *Ohara, Col. 2, Lines 23-32.*

Thus, Ohara merely describes a cap which is bonded using a gold film. The cap described in Ohara merely serves to protect the movable portion of the semiconductor acceleration sensor. The gold film is utilized as a bond via a eutectic technique and may function as an electromagnetic shield. Nowhere does Ohara disclose, teach or suggest an integrated circuit in the cap. Further, Ohara does not cure the defects of Merchant and Terasawa in that Ohara does not teach or suggest an alloy that is sufficient to remove a native oxide.

The Claims

Claim 1 recites "a bond structure ... composed of noble metal alloyed with an oxide affinity material having an affinity for oxygen higher than that of the material of which the semiconductor layer is composed ***such that the alloy is sufficient to remove a native oxide from an interface surface between the bond structure and the first substrate***". (emphasis added). The Office asserts that "there are no native oxide existed between the bond structure and the first and second substrates of Terasawa '962 and Merchant '181, therefore, the claimed term is met". *Office Action Dated January 5, 2005.* The Applicant respectfully and strongly disagrees.

As shown in the above excerpts, Merchant describes "a brief (i.e., approximately 1 to 2 minutes) 150 W rf sputter-etch cleaning of the chromium layer 29 surface just prior to application of the palladium layer 27 to the chromium layer 29". *Merchant, Col. 4, Lines 31-37.* Terasawa describes "ultrasonic cleaning with an aqueous solution of sulfuric acid and hydrogen peroxide, thereby removing organic substances and metals on the substrates". *Terasawa, Col. 9, Lines 13-16.* This is required in both these instances to form the bond structure because "adhesion of palladium to chromium has been found to depend directly on the cleanliness of the chromium layer 29 surface". *Merchant, Col. 4, Lines 31-33.* Thus, both Merchant and Terasawa teach a bond structure that requires separate cleaning of the substrates before application.

Thus, neither of the bond structures of Merchant nor Terasawa teach or suggest the recited bond structure of Claim 1 having an alloy that includes "an oxide affinity material ... such that the alloy is sufficient to remove a native oxide from an interface surface between the bond structure and the first substrate". There is no teaching or suggestion in either of the references for

such a feature because, as stated by the references and by the Office, other cleaning techniques are utilized to remove an oxide film. Additionally, these references may not be modified because such a modification runs contrary to the express teachings of the references as excerpted above. Further, the Office has failed to indicate where either of the references, alone or in combination, teach or suggest the recited alloy of Claim 1, but rather has ignored the recited features (e.g., "given no patentable weight"), which is described in greater detail below.

The Office asserts that the "expression 'such that the gold the alloy is sufficient to remove a native oxide from an interface surface between the bond structure and the first substrate' is/are taken to be a product by process limitation and is given no patentable weight". *Office Action Dated January 5, 2005, Page 5.* It is respectfully submitted that the Office has mischaracterized the features of Claim 1. The recited feature of the "alloy ... composed of noble metal alloyed with an oxide affinity material ... composed such that the alloy is sufficient to remove a native oxide from an interface surface between the bond structure and the first substrate" as recited describes an amount of oxide affinity material included in the alloy. The recited feature does not recite a process step. As stated by the MPEP, a product by process claim "is a product claim that defines the claim product in terms of the process by which it is made". *See MPEP, 2173.05(p).* In the present case, however, the recited feature describes an amount of oxide affinity material that is included in the alloy and does not recite a process for making the alloy. Therefore, Claim 1 is not a product by process claim. Thus, the Office's assertion that "no native oxide existed between the bond structure and the first and second substrates of Terasawa '962 and Merchant '181, therefore, the claimed term is met" is

respectfully submitted to be incorrect. *Office Action Dated January 5, 2005, Page 5.*

Even assuming *for the sake of argument alone* that this feature recites a process in a product-by-process claim, the Office must still show how "[t]he structure implied by the process steps should be considered when assessing the patentability of product-by-process claims over prior art". *See MPEP 2113.* Therefore, the Office is to give the recited feature patentable weight even in the instance of a product-by-process claim and must show where the structure formed by the process is taught or suggested by the references. Therefore, the Office's assertion that "a product by process limitation and is given no patentable weight" does not meet this requirement and is contrary to the express requirements of the MPEP. *Office Action Dated January 5, 2005, Page 5.* Further, it should be noted that absent such a showing, the burden does not shift to the Applicant. *See MPEP 2113.*

Accordingly, for at least these reasons a *prima facie* case of obviousness has not been established with respect to Claim 1 and withdrawal of the rejection is respectfully requested.

Claims 2-4 and **6-9** depend from independent Claim 1. Each of these claims is allowable based on their respective dependencies as well as their own recited features which are not disclosed, taught, or suggested the references of record, alone or in combination.

Claim 10 recites "gold alloyed with an oxide affinity material having an oxygen affinity higher than that of silicon such that the gold alloyed with the oxide affinity material is sufficient to remove a native oxide from the first semiconductor wafer". Claim 10 is allowable based on similar reasoning as previously recited for Claim 1. As previously described, there is no teaching or suggestion in neither Merchant nor Terasawa, alone or in combination, for the

recited feature. Additionally, these references may not be modified because such a modification runs contrary to the express teachings of the references and even the assertions made by the Office.

The Office also asserts that the "expression 'such that the gold alloyed with the oxide affinity material is sufficient to remove a native oxide from an interface surface between the bond structure and the first substrate' is/are taken to be a product by process limitation and is given no patentable weight". *Office Action Dated January 5, 2005, Page 7.* It is respectfully submitted that the Office has also mischaracterized the features of Claim 10. The recited feature describes an amount of oxide affinity material included with the gold. The recited feature does not recite a process. As stated by the MPEP, a product by process claim "is a product claim that defines the claim product in terms of the process by which it is made". *See MPEP, 2173.05(p).* In the present case, the recited feature does not recite process for making the alloy, but rather recites a composition of the alloy. Therefore, Claim 10 is not a product by process claim. Thus, the Office's assertion that "no native oxide existed between the bond structure and the first and second substrates of Terasawa '962 and Merchant '181, therefore, the claimed term is met" is again respectfully submitted to be incorrect and does not follow the procedure for examination prescribed by the MPEP, e.g., §§ 2113, 2173.05(p). *Office Action Dated January 5, 2005, Page 8.*

Accordingly, for at least these reasons a *prima facie* case of obviousness has not been established with respect to Claim 10 and withdrawal of the rejection is respectfully requested.

Claims 11 and **14** depend from independent Claim 10. Each of these claims is allowable based on their respective dependencies as well as their own

recited features which are not disclosed, taught, or suggested the references of record, alone or in combination.

Claim 15 recites a "gold alloy is configured to ***remove a native oxide from the silicon***; and provide an electrical connection between at least one said integrated circuit of the first semiconductor wafer with at least one said integrated circuit of the second semiconductor wafer". **Claim 33** recites a "first material having the dispersed reducing agent is configured to ***remove a native oxide from the first substrate or the second substrate;*** and form an electrical connection between a first integrated circuit on the first substrate with a second integrated circuit on the second substrate".

Claims 15 and 33 are allowable based on similar reasoning as previously recited for Claims 1 and 10 and therefore the Applicant will not further burden the record by repeating each of the arguments. As previously described, there is no teaching or suggestion in neither Merchant nor Terasawa, alone or in combination, for the recited feature. Additionally, these references may not be modified because such a modification runs contrary to the express teachings of the references and even the assertions made by the Office.

Further, the Application again respectfully submits that the Office has mischaracterized the features of the claims. The recited features describe an amount of oxide affinity material and do not recite a process. As stated by the MPEP, a product by process claim "is a product claim that defines the claim product in terms of the process by which it is made". *See MPEP, 2173.05(p).* In the present case, the recited feature does not recite a process for making the gold alloy, but rather recites a composition of the alloy. Therefore, Claims 15 and 33 are not a product by process claims.

Accordingly, for at least these reasons a *prima facie* case of obviousness has not been established with respect to Claims 15 and 33 and withdrawal of the rejection is respectfully requested.

Claims 16-17 depend from independent Claim 15. **Claim 34** depends from independent Claim 33. Each of these claims is allowable based on their respective dependencies as well as their own recited features which are not disclosed, taught, or suggested the references of record, alone or in combination.

Conclusion

For at least these reasons, Claims 1-4, 6-11, 14-17 and 33-34 are allowable and furtherance to issuance is respectfully requested.

Respectfully submitted,

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